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APPARATUS, AND AN ASSOCIATED METHOD, FOR DETECTING A MASS CALL EVENT AND FOR AMELIORATING THE EFFECTS THEREOF

CROSS-REFERENCE TO RELATED APPLICATIONS

5   The present application claims the priority of provisional patent application number 60/401,094, filed on 5 August 2002.

The present invention relates generally to a manner by which to facilitate detection of a mass call event in a telephonic network. More particularly, the present invention relates to apparatus, and an associated method, by which automatically to

10   detect the occurrence of the mass call event and, once detected, to permit network operation automatically to be altered, automatically to ameliorate network congestion caused by the mass call event.

Automatic detection of the mass call event and automatic implementation of steps to ameliorate congestion conditions caused by the mass call event permits quicker

15   resolution of the problems associated with the mass call event than when relying on manual intervention to detect and ameliorate the problem. Statistical computations are used to derive parameters that facilitate the detection of the mass call event, permitting reduced amounts of data gathering and processing in the detection process. And, amelioration of the mass call event is carried out in a systematic manner, permitting a

20   selected call rate of calls to be connected while the mass call event continues.

BACKGROUND OF THE INVENTION

Use of telephonic networks through which to communicate is an endemic part of modern society. Telephonic communications are effectuated pursuant to many types of communication services as well as, perhaps most pervasively, to effectuate voice

communication services. Public-access telephonic networks are widely deployed and are regularly through which to effectuate the telephonic communications.

The telephonic networks that encompass various geographical areas are interconnected. And, when suitably interconnected, telephonic communications are

5   effectuable between telephonic stations connected to, and forming part of, almost any of the telephonic networks that are interconnected there together. Thereby, telephonic communication services are effectuated between locations at which access to a telephonic network is available.

A telephonic network comprises a communications fabric that includes, e.g., a

10   signaling network and switching entities. Telephonic stations forming calling stations are connected to the switch entities, and telephonic stations forming called stations are also coupled to switch entities. The switch entities perform switching functions and are operable, together with operation of the signaling network to form call connections between calling and called stations. When a call connection is formed, telephonic

15   communication between the calling and called stations is permitted.

When telephonic communications are to be effectuated between a calling and a called station, dialed digits associated with the called station are entered at the calling station, such as by user actuation of a telephonic keypad in some telephonic networks. An IAM message, for instance, is formed as part of a call set-up procedure. The IAM

20   message includes values of the dialed digits associated with the called station. Additional signaling is generated as call set-up procedures are carried out, pursuant to conventional operation of the telephonic network. A call request is routed to the called station, and the call is accepted at the called station. The call connection is formed and the telephonic communications commence. When the communication session during

25   which the telephonic communications are effectuated is completed, the communication session is terminated, by sending a release message through the signaling network, and the call connection is terminated.

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While the number of concurrent call connections that are capable of formation in the telephonic network is, usually, large, the number of concurrent call connections that can be formed is not infinite. That is to say, the telephonic network is of a finite capacity. And, the telephonic network is constructed to be of a selected size, i.e., to

5   permit a selected level, or capacity of concurrent call connections to be formed. When the capacity of the network is exceeded, call attempts, i.e., attempts to form call connections, fail.

A careful balance between competing goals of increasing the size of the telephonic network and minimizing the costs of the telephonic network is made when

10   selecting the size, i.e., the capacity, of the network. While maximizing the size of the telephonic network minimizes the possibility of the occurrence of call connection attempts that exceed the capacity of the telephonic network, the costs associated with a telephonic network of such capacity would be prohibitively expensive.

Telephonic networks are correspondingly more regularly constructed to be of

15   capacities that permit all of the call connections that are normally requested within a selected standard deviation. That is to say, telephonic networks are typically constructed to be of capacities that permit all of the call connections, within a selected standard deviation, or other normative value, to be completed. When concurrent call connections are attempted in excess of this number, not all of the call connections can

20   be formed. Call connection failure results for at least some of the call connection attempts.

A significant increase in call connection attempts to a called station or a set of called stations is sometimes defined as being a mass call event. During a mass call event, the number of call connection attempts might approach, or exceed, the capacity of

25   the telephonic network. The influx of the call connection attempts causes network congestion that might prevent the completion of revenue-generating calls, thus adversely affecting the profitability of the network.

Mass call events are sometimes caused by generalized mass media initiated calls, such as request for responses to polls, voting, drawings, and fund raisers. These occurrences are generally characterized by a large number of call connection attempts to a specific station within a short time period. And, the call connection attempts are not

5   controlled at the destination, i.e., the called station, or stations, location.

Conventional efforts to reduce the deleterious effects of a mass call event require an operator of the telephonic network both to manually detect the mass call event and then to intervene manually. The time period required both to detect and to intervene manually is sometimes lengthy, necessitating excessive amounts of time in which to

10   ameliorate the effects of the mass call event.

If a manner could be provided by which better to more quickly detect the occurrence of a mass call event, and to ameliorate the effects of the mass call event, improved telephonic network performance would be provided.

It is in light of this background information related to telephonic networks that

15   the significant improvements of the present invention have evolved.

SUMMARY OF THE INVENTION

The present invention, accordingly, advantageously provides an apparatus, and an associated method, by which to facilitate detection of a mass call event in a telephonic network.

20   Through operation of an embodiment of the present invention, a manner is provided by which automatically to detect the occurrence of the mass call event. And, once the mass call event is detected, network operation automatically is altered, automatically to ameliorate network congestion caused by the mass call event. Because the mass call event is automatically detected, and steps to ameliorate congestion

25   conditions are automatically implemented, quicker resolution of the problems associated with the mass call event is provided in contrast to conventional reliance upon manual intervention to detect and to ameliorate the congestion conditions.

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Derived parameters are formed based upon statistical computations to facilitate

the detection of the mass call event, thereby to provide for detection of the mass call

event responsive to the collection of reduced amounts of data and processing thereof.

And, a systematic manner is carried out to ameliorate the mass call event to permit

5   connection of calls at a selected call rate. The mass call event is ameliorated in a

controlled manner by permitting call connections to be formed at a controlled rate with

called stations associated with the mass call event for so long as the mass call event

continues.

In one aspect of the present invention, a mass call event detector is embodied in

10   a signaling network and operates to detect occurrence of a mass call event. The mass

call event detector is positioned to receive indications of attempts by calling stations to

form call connections with called stations. The indications are IAM messages generated

pursuant to conventional call set-up procedures. When detection is made of a mass call

event, the detector generates indications of the detection that are provided to network

15   elements that, upon their detection, are used to ameliorate the call congestion caused by

the mass call event.

The mass call event detector is embodied, for example, at an application

processor of a STP (signaling transfer point). IAM messages are forwarded to the

signaling transfer point by switch elements that are connected to calling stations that

20   initiate call requests. A mass call event is a network-operator-defined level of calls

placed to a particular calling station, or calling stations, within a selected time period.

A match criteria, a value related to the operator-selected threshold value, is used by the

mass event detector by which to detect the occurrence of a mass call event.

The mass event detector, in one implementation, utilizes a two-tier detection

25   procedure. During first tier detection procedures, the detector monitors all IAM

messages that are generated pursuant to call set-up procedures by monitoring portions,

such as the final four digits of telephonic identifiers of the called stations identified in

the IAM messages. Monitoring continues for a selected sampling period derived . Any

called station identified in IAM messages that meet the match criteria forms a "suspect"

mass-call-event called station. Continued monitoring is performed of the number, or

numbers, of the suspect called stations. The second period forms a second tier

monitoring period. If, during this second tier monitoring period, the telephonic

5   identifier identifying the called station, or stations, is again detected in the IAM

messages in excess of the match criteria, the associated called station is determined to

be a party to a mass call event.

When the mass call event is detected by the mass call event detector, the number

of call connections that are permitted to be completed between calling stations and the

10   offending called station is limited to a selected number of call connections within a

selected time period. That is to say, the rate at which call connections are permitted to

be made to the offending called station is limited, thereby to control the number of call

connections that are made during any period, measured during the duration of the mass

call event. When the mass call event is no longer detected, the limitation on the call

15   connections that are permitted to be formed is removed. Normal telephonic network

operation thereafter again commences.

Thereby, automatic detection, and steps to ameliorate the effects of, a mass call

event are carried out without the need for human intervention. Delays associated with

conventional need to manually intervene in some manner in the detection or to take

20   steps to ameliorate the problems associated with the mass call event are obviated.

In these and other aspects, therefore, apparatus, and an associated method, is

provided for a telecommunications network. The telecommunications network has

network elements, and call connections are formed between calling stations and called

stations to permit telephonic communications to be effectuated. Amelioration of

25   network congestion caused by a mass call event is facilitated. A mass call event occurs

when a plurality of call connections are requested to be made to a selected set of called

stations within a selected time period. A mass call event detector is adapted

automatically to receive indications of selected attempts to form call connections

between selected calling stations and selected called stations during operation of the

telecommunications network. The mass call event detector detects occurrence of the

mass call event responsive to the indications of the selected attempts. A notifier is

coupled to the mass call event detector to receive indications of detection of occurrence

5   of the mass call event. The notifier notifies the network elements of the mass call event,

automatically and free of network interaction. In the exemplary implementation, the STP

does not notify other network elements of the event; rather the STP releases the calls to

offending number at the rate specified by the user.

A more complete appreciation of the present invention and the scope thereof can

10   be obtained from the accompanying drawings that are briefly summarized below, the

following detailed description of the presently preferred embodiments of the invention,

and the appended claims.

BRIEF DESCRIPTION OF THE DRAWINGS

Figure 1 illustrates a functional block diagram of a telephonic network that

15   includes an embodiment of the present invention as a portion thereof.

Figure 2 illustrates a functional block diagram of a signaling transfer point (STP)

that forms a portion of the telephonic network shown in Figure 1 and that is operable

pursuant to an embodiment of the present invention.

Figure 3 illustrates a representation of an exemplary array formed during

20   operation of an embodiment of the present invention and used in a preliminary detection

of a mass call event.

Figure 4 illustrates an exemplary representation, similar to that shown in Figure

3, but of an array that is formed during operation of an embodiment of the present

invention to detect the occurrence of a mass call event.

25   Figure 5 illustrates a method flow diagram listing the method steps of the method

of operation of an embodiment of the present invention.

DETAILED DESCRIPTION

Referring first to Figure 1, a telephonic network, shown generally at 10, operates to provide for communications between communication stations, here telephonic stations that are connected to, or otherwise operable in, the telephonic network. The

5   telephonic network is representative of any various types of telephonic networks that provide for telephonic communications. That is to say, the telephonic network 10 is representative of any of various, conventional telephonic networks that operate to form call connections between telephonic stations forming stations and telephonic stations forming called stations. Upon formation of call connections between the calling and

10   called stations, telephonic communications are permitted. Communication of both voice and non-voice data is permitted between the calling and called stations.

The elements forming the network 10 are functionally represented and, in an actual implementation form either, or both, logical and physical entities. The telephonic network also includes additional elements and entities, not separately shown, for

15   purposes of simplicity. It should be understood, of course, that, in an actual implementation, additional entities and elements form portions of the telephonic network.

The telephonic network includes a signaling network 14 to which a plurality of switch elements 16 are connected. The switch elements are, in turn, coupled to

20   telephonic stations 22.

Any of the telephonic stations 22 can initiate a call to another telephonic station. And, any of the telephonic stations can receive a call initiated by another of the telephonic stations. A telephonic station that initiates a call to another telephonic station is sometimes referred to as a calling station, or an originating station. And, a

25   telephonic station with which another telephonic station initiates a call is referred to as a called station or terminating station. Such terminology shall be used herein.

When a call is initiated, call set-up procedures commence. An IAM message, for instance, is generated by a switch element that is coupled to a calling station. The IAM message is here generated on a line 25. The IAM message includes values of the dialing digits, that is, the telephone number, of a called station to which the call connection is

5   requested.

The signaling network includes one or more signaling transfer points (STPs), of which a single transfer point 26 is shown in the Figure. The signaling transfer point is coupled to the switches 16. During operation, the signaling transfer point operates as a switching center that provides for the transfer from one signaling link to another. When

10   the telephonic network forms a common-channel signaling network, the call that is associated with the signaling is routed through the signaling transfer point. And, when the telephonic network forms a non-associated, common channel signaling network, the signal transfer point need not be the point through which a call, which is associated with the signaling being switched, passes. The telephonic network is representative of either

15   a common-channel signaling network or a non-associated, common-channel signaling network and the signaling transfer point is correspondingly representative of a STP operable in either of such types of networks.

The telephonic network is constructed to be of a selected capacity, that is, of switching and processing capacity to permit a selected activity level. The capacity of

20   the telephonic network is determinative of the number of concurrent call connections that can be made during its operation.

While the telephonic network is typically sized to be of a capacity corresponding to typical, anticipated usage thereof, the network typically is not sized to be of a capacity permitting every telephonic station therein concurrently to be involved in a

25   communication session in which a call connection is formed by every one of the telephonic stations. In typical usage, only a fraction of the telephonic stations connected to the telephonic network are involved in a call that requires a communication connection to be formed. However, in the event of a surge of call attempts, the capacity

of the telephonic network to form the requested call connections is exceeded. As noted previously, the occurrence of a mass call event in which a surge of call attempts in a short time period are made results in call congestion conditions that prevent the completion of the desired call connections at the rate at which the call connections are

5   requested.

The signal transfer point 26 includes apparatus 32 of an embodiment of the present invention. The apparatus 26 operates to detect and to facilitate amelioration of the call congestion, in a controlled manner, caused by the mass call event. The apparatus 32 is also functionally represented, formed of functional entities. The

10   functional entities forming the apparatus are implementable in any desired manner, such as by algorithms executable by processing circuitry. And, while the entities forming the signaling transfer point are represented to be embodied at the signal transfer point 26, the functions performed by the entities of the apparatus can also be distributed amongst more than one signaling transfer point, or embodied at other elements, other than a

15   signaling transfer point.

The apparatus includes a mass call event detector 34 and a notifier 36. The mass call event detector operates to detect the occurrence of a mass call event and to provide indications of the detection to the notifier. The notifier operates, responsive thereto, to notify structure of the telephonic network of the mass call event condition, thereby to

20   facilitate amelioration of the congestion conditions in a controlled manner to alleviate the congestion conditions. Operations performed by the detector and the notifier are performed automatically, free of manual intervention. Thereby, the detection is able to be made quickly, and amelioration of the effects correspondingly is able to be made quickly, without the need to await manual intervention to detect and correct for the mass

25   call event.

A network operator-generated input, here represented on the line 38, is used to help to define the mass call event. More particularly, the input value provided by the network operator is a value forming a threshold value that is used in the determination

of the occurrence of a mass call event. Through appropriate selection of the threshold

value, the network operator is able to control the number of call connection requests that

precipitate the indication by the mass call event detector of a mass call event.

Figure 2 illustrates the signal transfer point 26 that forms part of the telephonic

5   network 10 shown in Figure 1. The signal transfer point, in the exemplary

implementation, includes a plurality of application processors 44 and a plurality of

routing processors 46. The application processors are processors on which the mass call

event application of an embodiment of the present invention are running, or available

upon which to run. Each processor 44 'sees' a representative sample of all of the traffic

10   passing through the STP. The routing processors, in the exemplary implementation,

correspond in number with the number of the application processors. The routing

processors are coupled to receive the IAM messages routed to the signal transfer point

on the lines 24. And, the routing processors 46, upon detection of the IAM messages,

perform routing functions to route the call requests associated with the IAM messages.

15   And, the signal transfer point also includes a central management processor 52. The

central management processor forms the processor that performs the central

management of the mass call event notification. In an exemplary implementation, the

application processors form DSS processors, and the central management processor

forms a CCM processor.

20   One of the application processors 44 is designated as a processor that operates

pursuant to an embodiment of the present invention, that is, to include the apparatus 42

as a portion thereof or otherwise to perform the functions carried out by the apparatus.

The application processor that is selected, or otherwise nominated, to perform the

detection and notification operations is provided with indications of IAM messages

25   provided thereto. And, because the nominated application processor receives a

fractional part of the IAM messages provided to the signal transfer point, detections

made by the nominated application processor are representative, in a fractional manner,

of the total number of IAM messages delivered to the signal transfer point.

The IAM messages each include values identifying the called station, as well as the calling station that initiates a call to the called station. The nominated application processor analyzes the values, i.e., the values of the dialing digits of the received IAM messages pursuant to the mass call event detection. When a mass call event is detected,

5   the notifier forms a notification message that is provided to a central management processor 52. The central management processor, responsive thereto, alerts the other application processors of the mass call event detection. The other application processors, as well as the nominated application processor, in turn, limit the number of call connections that are permitted during any period, thereby to limit the congestion

10 that otherwise would occur as a result of uncontrolled call connection during a mass call event. And, as a selected number of call connections are permitted by each of the application processors, some call attempts result in successful call connections. The limitation on the number of call connections to a called station that is identified pursuant to the mass call event detection continues for the duration of the mass call

15 event. Thereby, congestion conditions of the mass call event are ameliorated.

Various parameters are utilized in the operation of the apparatus embodied at the nominated application processor. A threshold rate is one of such parameters. The threshold rate is the rate of calls per second to a specific telephone number, i.e., called station that is considered a mass call event. And, action is another of such parameters.

20 The action is the rate of calls per second to the suspect telephone, i.e., the called station to pass through the signal transfer point during the mass call event after which the calls will be returned with a provisionable release cause. And, a match criteria is the threshold rate, divided by the number of application processors, then multiplied by a sampling period.

25 With, potentially, thousands of messages per second flowing through the routing and the application processors, statistical computations are used to derive additional parameters. The parameters are noted below:

# AP	Matches	Sample Period	Real Rate	Probability	Annual Events	80% Rate	Messages	Delta
1	60	2.0	30	2.1E-114	0.00	24	48.00	12.00
2	30	2.0	30	4.99E-49	0.00	24	24.00	6.00
3	20	2.0	30	9.98E-30	0.00	24	16.00	4.00
4	15	2.0	30	7.86E-21	0.00	24	12.00	3.00

The amelioration of the call congestion caused by the mass call event functions as an extension of a triggerless call type blocking feature. When this feature is active, all IAM messages are routed to the application processors for query processing.

In the exemplary implementation, the application processor that is utilized to detect the mass call event is selected by the central management processor during system initialization. The apparatus, in another implementation, is embodied at more than one, or all, of the application processors and the central management processor selects which of the application processors is to be nominated.

Also in the exemplary implementation, mass call event detection is made as a two-tier process. During the first stage, that is, the first tier, of the detection process, a 10,000 byte array, illustrated in Figure 3, shown generally at 58, is formed. The array is formed of the possible values of the final four digits of the telephone number of the called party, contained in each of the IAM messages. Peg counts, indicated in each row 62 of the array, are maintained. And, a count of the detected values of each, or any, of the 10,000 possible values of the final four digits of the called station telephone number is maintained during a sample period. The match criteria, defined to be the threshold value divided by the number of application processors, multiplied by a sample period defines a value that, if a count value is in excess of such value, a telephone number is considered to be a 'suspect' called station. Here the digits '6666' meet the match crieteria and identify a suspect called station.

During a next subsequent sample period, a second-stage, that is, the second tier procedure commences in the event that a suspect called station is identified. Otherwise, the second tier procedure does not commence. A second array, shown generally in

Figure at 66, is formed during the second stage detection procedure. During this stage, each telephone number that met the match criteria in the first stage detection procedure is now a suspect number. That is, here, any telephone number having the final four digits of '6666.' During this stage two procedure, the nominated application processor

5   continues to monitor IAM messages and to compare each one to the list of suspect numbers. In the exemplary implementation, the sample period during the second stage procedure corresponds to the sample period of the first stage procedure.

At the end of the sample period, the suspect number, or numbers, that again meet the match criteria are now considered to be the offending numbers. That is, telephone

10   numbers associated with called stations that are parties to a mass call event.

Notification of the identities is provided to the central management processor (shown in Figure 2). The central management processor then distributes the offending number or numbers, as well as provisioned action to all of the application processors of the signaling transfer point. The application processors each then permit pass through

15   of only a provisioned number of calls for each offending number, and the remainder of the calls are terminated with a release cause. By permitting some calls through for the offending number, the action prevents calls to the offending number from generating congestion at the destination. Class 4 switches, and others, also prevent the calls to the offending number to cause other revenue-generating calls to be lost due to congestion.

20   The nominated application processor continues tier one and tier two detection operations while a mass call event is in effect. When the match criteria is no longer valid, the mass call event is considered to have ended, and the central management processor is notified. And, in turn, the central management processor sends a message to all of the other application processors to indicate that the mass call event has terminated.

25   Figure 5 illustrates a method flow diagram, shown generally at 72, representative of operation of an embodiment of the present invention. The method facilitates amelioration of network congestion caused by a mass call event in a telephonic network

in which a plurality of call connections are requested to be made to a selected set of

called stations within a selected time period.

First, and as indicated by the block 74, occurrence of the mass call event is

detected responsive to indications of selected attempts to form call connections between

5   selected calling stations and selected called stations during operation of the telephonic

network. Then, and as indicated by the block 76, network elements are notified of the

mass call event responsive to detections of the mass call event. The notifications are

made manually and free of manual interaction.

Thereby, a manner is provided by which automatically to detect and to initiate

10   amelioration of congestion caused by a mass call event.

The previous descriptions are of preferred examples for implementing the

invention, and the scope of the invention should not necessarily be limited by this

description. The scope of the present invention is defined by the following claims: